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ABSTRACT

This four-section paper begins with a brief description of videotex and the paths its development has followed during its short lifespan. The second section examines how videotex systems should present and display information, and how such information should be internally organized so that it is maximally useful for the reader/user. The analysis, which draws heavily on work done during several videotex field trials in the United States, Canada, and other countries, incorporates insights from human factors studies of video display terminals, research on typography and graphic display, and work on the design of interactive systems and computer help facilities. The third section addresses some significant policy issues that affect instructional uses of videotex, including questions of equity, privacy, and secrecy. Finally, several possible future scenarios for the development of videotex as an instructional medium are discussed, and the suggestion is made that the convergence of videotex with other emerging technologies may result in novel arrangements for electronic publishing and new opportunities for improved instructional design. Fifty-six references are listed. (LMM)

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Videotex in Education: Current Developments in Screen Design, Data Structure, and Access Control

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Abstract

Development of videotex information systems is currently proceeding at a fast pace. While these systems are expected to be popular for business and home use, educators have as yet paid scant attention to their potential for instruction. Three questions about the design and use of videotex systems should be of special concern for educators. First, the way in which information is presented on the screen may differ markedly from traditional norms of layout for printed texts; typography, text density, color, and the use of graphics all become problematic when one is preparing videotex screens. Second, provision must be made carefully for "way-finding systems" in videotex so that users do not become lost. Third, important policy questions remain to be discussed around such issues as equity, access, and privacy. Videotex promises to change educators' thinking about the nature of text materials in general, and about the design of electronic information in particular.

Videotex in education:

Current developments in screen design,

data structure, and access control

Prologue: Videotex Icebergs on a Technological Ocean

Technological advances are like icebergs. Delightful to observe from afar, they may become ominous as one moves closer. And like icebergs, changes in technology are often not what they seem to be at first glance: what appears as a large and substantial mass may on further inspection turn out to be merely a weak shell, whereas something that seems to be relatively insignificant when spotted on the horizon may later reveal hidden qualities that make it a force to be reckoned with.

Publishers, writers, and educators attempting to discern the future of printed instructional materials and the ways that technology may affect that future must feel themselves uneasily in the position of yesteryear's transatlantic steamship captains: they know that there are icebergs out there, but they find it very difficult at present to tell which pieces are just patches of floating pack ice, and which bergs are the truly significant ones, hiding the bulk of their impact in the ocean depths until time brings them close enough to discern more completely.

Videotex is one such iceberg. Publishers, broadcasters, and (to a more limited degree) writers and educators are aware that videotex information systems are "out there"; but members of these groups probably evaluate differently the changes that videotex may bring to the design of materials for instructional purposes. It is my intent here to offer an outline of several central issues involved in this question.

The analysis may serve as a kind of iceberg detector that would allow us to assess the significance of videotex for the design of instruction; it may also permit us to make judgments about the potential impact of videotex as a tool for education rather than as a consumer service.

Introduction: Issues in Designing Videotex for Instruction

This paper is divided into four sections. In the first, the reader will find a brief account of what videotex is and what paths its development has followed during its short lifespan. The intent here is not to be exhaustive, for there are already works that do an excellent job of outlining the history of videotex, but rather to give an overview for the uninitiated.

The second section of the paper tackles the essence of the problem: how should information that is to be made available via a videotex system be presented and displayed, and how should it be internally organized so that it is maximally useful for the reader/user? The analysis here draws heavily on work done during several videotex field trials in the United States, Canada, and other countries, but it also incorporates insights from several related areas--human factors studies of video display terminals, research on typography and graphic display, work on the design of interactive systems and computer "help" facilities, and so on. The central thrust of this section is summed up in the dual question, "Compared with information that is presented in book form, how should videotex information look, and how should that information be structured so as to allow users maximally efficient access?"

In the third section of the paper, some significant policy issues are addressed that affect how videotex may be used toward instructional ends. These include questions of equity, privacy, and secrecy. Finally, the last part of the paper deals with several possible future scenarios for the development of videotex as an instructional medium, and suggests that the convergence of videotex with other emerging technologies may result in novel arrangements for electronic publishing and new opportunities for an improved instructional design.

A Brief History of Videotex from Earliest Times to the Present

This is not the place to give a comprehensive history of how videotex came to be, why it has developed as it has, or how it can best be marketed to executives in multi-national corporations. Those tasks have already been performed admirably by others, and the truly curious reader should consult Tydeman et al. (1982), Sigel (1980), Fedida and Malik (1979), Woolfe (1980), or Godfrey and Chang (1981) for complete treatments. My desire, rather, is to provide an overview for those who may have at present only a sketchy idea of what videotex is and how it works.

Some definitions. "Videotex" is a term used to describe electronic systems for storing and retrieving textual and graphic information by using a modified home television receiver. Under this general heading, we can identify two varieties of videotex:

(1) Teletext--a form of videotex that is broadcast by a television station as part of the video signal. Broadcast teletext is relatively limited in the scope of information that can be presented to about 100

pages. This contraint is imposed both by the time needed to broadcast the entire cycle of pages and by the delay users are willing to put up with before a page they have selcted appears--about 25 seconds in most systems. And teletext is essentially a one-way medium; the user can request (using a "keypad") any of the 100 pages available through that channel, but if the desired information is not on those pages, there is no other place to look. (A variant on regular broadcast teletext is "cabletext," in which an entire cable television channel is devoted to teletext signals. This increases the potential capacity of a teletext system to several thousand pages.)

(2) Interactive videotex--in which the user is linked directly (usually via telephone lines) to a large computer database containing many thousands of pages of information. Such systems may also offer enhanced possibilities for interaction through "teleshopping" or "telebanking" facilities. The user can search for any item of information that is in the database, and is guided through the structure of the information by a set of "menus" that make it feasible for those without extensive training in computers to participate. (The use of the term "videotex" in both a generic and a specific, interactive sense is one of the stumbling blocks to those entering this field for the first time; the British, who pioneered in the area, at first used the term "viewdata" in a generic sense.)

It is difficult to give a good idea of the content of a videotex database (whether teletext or interactive videotex) in the absence of a television screen and keypad for calling up frames of information. Typical contents of operating systems feature a variety of news items

(including sports results), weather, and current financial information (e.g., market results, commodity prices, etc.) Additionally, there may be special "entertainment" sections with recipes, how-to columns, advice to the lovelorn, horoscopes, and perhaps a bulletin board or "classified" section of some sort. Interactive systems may have more sophisticated facilities for making travel reservations, shopping or banking from home, receiving microcomputer software from a central computer file, and having various sorts of material (e.g., school catalogues, consumer information) sent to one's home.

British and European contributions. The initial development of videotex took place in Britain. In the early 1970s, British Telecom (the government agency responsible for operating the telephone system) hoped to find a way to encourage more use of the telephone network during evening hours. A system that would link home television sets to computer databases using telephone lines was proposed and trials were started by 1974. By 1979, those with access to a television set had available two operating teletext systems--"Ceefax" on the BBC, and "ORACLE" on ITV--and an interactive videotex system, British Telecom's "Prestel." Public acceptance of Prestel has been slow--there are still only about 20,000 subscribers; teletext, however, appears finally to have reached a point of "take off"; the number of teletext sets in use grew from fewer than 200,000 in 1981 to a projected 600,000 by the end of 1983.

Other European countries set to work on their own videotex systems. France has undertaken field trials of a videotex system ("Teletel") that would eventually replace the telephone book and allow citizens to do

much of their shopping from home. West Germany has its "Bildschirm-text", and German designers have been particularly interested in the possibilities of using the system as a surrogate for banking and other financial transactions. Japan's "Captain" system has also been undergoing field trials, although the Japanese have had to cope with some significant problems involving the generation and on-screen display of the Chinese ideographic characters (kanji) that are used in conjunction with the phonetic Japanese characters.

North American developments. Canada pioneered in videotex in the late 1970s by introducing a new standard, "Telidon", that permits much more precise graphic images to be created on the screen than is the case with the British Prestel system. Telidon, which can address individual points on the screen (and is thus "alphageometric", in contrast to the cruder "alphamosaic" images possible in Prestel), promises to become the North American standard.

The United States government, for a variety of reasons too complicated to go into here, decided not to support officially the development of videotex as had Canada and the European countries. To date, the US has witnessed only a few field trials and some "hobbyist" videotex systems (notably Compuserve Information Service and The Source). Warner-Amex has been operating the "Qube" system, a kind of modified videotex arrangement, in Columbus, Ohio, for the past five years. Field trials and market tests abound--CBS, AT&T, IBM, Time-Life, and many of the nation's largest newspaper chains have been involved; one recent compilation lists 53 systems either in operation or in some stage of testing or planning (Status, 1983). And a few articles have

begun to appear in the popular press, perhaps preparing the citizenry for future advertising campaigns by system operators (Friedman, 1983; Kiester, 1983).

Differing views of the future. During the first few years after the introduction of videotex systems in Great Britain, the tone of popular writing about this new technology was markedly optimistic. The title of one article is indicative: "Fireside access to sum of human knowledge" (Hamlyn, 1981). When initial counts of subscribers failed to meet expectations, however, the emphasis changed; videotex was now hailed primarily as a tool for business, a way for the executive to tap a variety of useful data sources. That confusion continues today in the field trials and market tests of videotex in the United States. Some operators maintain that they are only interested in designing and running systems for business, while others seek to define the "home market" and discover what services people might be interested in having, using, and (perhaps most significantly) paying for.

Partly because of this confusion, and partly because of the miscellaneous nature of the content of early videotex databases (such as Prestel, Compuserve, and The Source), the community of educators, publishers, writers and others concerned with the instructional design of printed materials has not taken much notice of this new medium. My strong sense is that this lack of attention is a mistake, and that videotex is in reality much more than the sum of its parts.

What we need to do is think of videotex not as limited by present-day technology or the specifics of any one of the competing "brand-name" systems, but rather as a general approach, a way of preparing, storing,

and using textual and graphic materials at a distance. The real impact of videotex will eventually stem from the fact that such systems will affect large numbers of people. Videotex will, for the first time, force a significant portion of the population to deal with information stored and presented in electronic form. The remainder of this paper is devoted to an exploration of several issues that it will be important to bear in mind as we move toward that transformation in consciousness.

The Design and Presentation of Information on the Screen

The first significant difference between information presented traditionally through books or other printed materials and that presented through videotex-like systems is the way in which the information itself meets the user's eye. The design of printed materials is based on several centuries of art and science, and we have built up a goodly collection of guidelines to tell us what a printed page should "look like" (see, for example: Hartley, 1978; MacDonald-Ross, 1978; Rice, 1978, for examples of our current best knowledge about the design of printed materials). Perhaps because we started from the assumption that video displays and paper pages were identical (and have only recently realized that they are not), we have just begun to get a sense for what a CRT screenful of information should look like. And it is becoming increasingly clear that it does not necessarily look like a printed page at all.

This section reviews several variables that have an impact on screen design: typography (the style, size, and shape of letters); the density of text (line and paragraph length, spacing, and so on); color;

the value of and most effective use for graphics of various kinds; a variety of other human factors that must be taken into account when designing screens; and finally, the overall effect of the designer's particular combination of text and graphic elements in the screen layout. Each of these will be treated in more detail below.

Typography. It has become something of a truism to urge that the typographical designer of printed materials eschew two things: the use of sans-serif type for extended text, and the use of upper-case lettering in any but the most restricted applications. These caveats were based on considerable research on human perception and pattern recognition. Lower-case letters, it seems, are more distinctive than upper-case, and therefore easier to read when massed together. Likewise, serifs (the short "bars" on the ends of many letter elements; note, for example, the bottom of the letter "l") appear to help the eye make out which letter is which.

These two limitations posed immediate problems for the designer doing layout for a videotex screen: the low resolution that videotex engineers had to plan for (given use of home television receivers) meant that obtaining adequate resolution with lower-case letters would be difficult. Also, the matrix of pixels (individual dots on a screen) used to form characters was in most cases not sufficiently large to show serifs accurately. Consequently, those considering typography for videotex systems at first cautiously recommended guidelines based on print norms: use a mixture of upper and lower case letters, and try to develop type faces specifically adapted for video display (Carey, 1981a; Reynolds, 1979).

Recent work, however, has cast some doubt on these earlier recommendations. One important realization has been that, given present-day costs and technological limitations, people are unlikely to sit down and read large amounts of information of a screen. As one wag noted, it is fully possible, with today's videotex systems, to enter the full text of War and Peace, and for system users to call it up and read it, but no one is seriously proposing that this be done. Rather, users tend to scan videotex screens, searching for particular items of information (Champness & DiAlberdi, 1981) and that therefore the "net effect is additive, not continuous (Siegeltuch, 1982, p. 32).

Recent empirical studies have shown that in fact it may take users somewhat longer (although not significantly so) to read all-upper-case materials on videotex (Foster & Champness, 1982). Also, when queried about their ability to read videotex materials easily, a large majority of users (between 88 and 97%, depending on the particular study) indicated that they had no trouble (Elton, Irving, & Siegeltuch, 1982; Teletext, 1982). In one field trial, the number of users who reported problems declined by several percentage points as they "got used to" the system (Irving, Elton, & Siegeltuch, 1982).

What this recent empirical work shows is that we should not be too swift to generalize from research on print typography to videotex systems that display print in a new format. While the processes involved in reading from printed page and video screen may appear to be parallel, they may in fact be quite different; users may be developing a new way of scanning printed information that will allow them to compensate for the lower quality of letter respresentation possible with

today's video screens.

Text density. Videotex frame designers soon realized that they were working with a medium different from print when they confronted the physical limitations of the screen for displaying information. In most videotex systems, the screen format allows for a maximum of 80 characters per line, and 24 lines per screen. From the beginning, designers were urged to use only about one-third of the total screen capacity, or roughly 70 words per screen (Reynolds, 1979). This restriction meant that one screen would hold about as much as one inch in a standard newspaper column; in the case of broadcast teletext, where one would be working with a maximum of perhaps 100 screens, this would put the total content of the database at somewhat less than the front page of a daily newspaper (Nisenholtz, 1981).

Given the tendency (noted above) of users to scan pages rather than read them, it should come as no surprise that using considerable amounts of space to break up the screen leads to significantly improved legibility. Indeed, designers are urged to make "paragraphs" no more than three to six lines long. Interestingly enough, users still seem to prefer a line of text with more characters in it (70-80) rather than a 35-character line (Kolers, Duchnicky, & Ferguson, 1981). And, as with the typography of videotex, it seems that experienced users become more tolerant of the limitations of the medium--a survey of teletext users found that 56% wanted more information packed onto single screens (Teletext, 1982).

Another unusual phenomenon is the sense that appears to be developing among both designers and users that each videotex screen

should be thought of as an entity unto itself, rather than as one in a sequence of pages or screens. In an electronic database, there is not necessarily any "before" and "after"; frames are accessed in the order that the user prefers. There is evidence that less than half of users will pursue a story that begins on one screen to a following screen, and that the percentage diminishes even further when more than two screens are linked together. Consequently, a new definition of "page" may be coming into being--one specialist has likened the preparation of videotex screens to the writing of 25-second radio spot commercials, a style of writing "with no obvious middle or end" (McFarland, 1982; see also Siegeltuch, 1982).

Color. Again in the case of color we find that norms that have evolved over the years for how to present material on the printed page may actually hinder the designer when it comes to preparing videotex screens. The print-based designer always had to assume that to add color was to add expense--each additional color meant an additional run through the press, with concomitant losses of time, wastage of materials, and increased labor costs. Consequently, color was used only when absolutely necessary, and usually as a way of distinguishing material that was truly different or important. Readers, over the years, became used to these conventions, and came to expect color to have significance.

In preparing videotex screens, however, color is no longer an expensive option; rather, it is now available at the push of a few keys. The designer is therefore faced at once with the pleasant prospect of being able to use color extensively, but also with the quandary of how

to use it effectively and with some sense of its place in the overall design of the screen.

In videotex, what is significant about color choice is not the color itself, but rather the context in which the colored material is to be viewed. The eye perceives differently light that is reflected off a page of print and that which is emitted from a phosphorescent video screen. On a page, red ink on a white background may stand out, but the effect may not be as pronounced on a screen because of differences in luminance. As it happens, white, yellow, and green are the colors with highest luminance when displayed on a video screen (especially when shown on a dark background, the norm for most videotex presentations), and it therefore seems to make sense to use one of these colors as a basic text color (Carey, 1981a; Reynolds, 1979). In fact, there seems to be a general tendency for humans to perceive differences in brightness more easily than differences in color, which would also support the use of white/yellow/green for text (Champness & DiAlberdi, 1981; Engel, 1980; Siegeltuch, 1982).

Color coding is a formatting procedure that it is much easier to use in videotex than in print. Some research that has been done on this technique shows that this sort of emphasis will be most effective when applied to blocks or groups of rows of text, rather than to individual rows (Foster & Champness, 1982). Although some have expressed doubt about the value of color coding (e.g., Tullis, 1981), there seems to be a general consensus that it can be useful at least on occasion (see especially Sutherland, 1980, and Waller et al., 1982).

A recommendation for coding information that contains data of

varying levels of significance is to use the brightest colors to indicate the information of greatest import, with less bright colors showing less critical material (this appears sensible, given the results on luminance discussed above; Reynolds, 1979). All in all, the watchword in use of color seems to be to use it consistently from screen to screen, and not to devalue through overuse its residual impact as a marker of significant information.

Graphics. Videotex seems likely to encourage the design of graphics to compress complex information and to help users conceptualize problems. The reasons that the word "likely" seems justified here are two: first, the current technical specifications for most videotex systems make relatively simple graphics (outlines, charts, diagrams, etc.) comparatively easy to create, store, and display, whereas other graphic material (photos, moving television or film images) would be very difficult to incorporate in videotex databases. Second, and to some extent because of the limitations noted above, videotex may be able to capitalize effectively on what is now increasingly perceived as a general feature of human information processing: a tendency to receive, organize, and store information in the form of simplified ("outline" or "cartoon" graphic) figures.

This preference for graphics appears to be rooted in the basic nature of the perception. Humans are "edge perceivers"; that is, we have special physical abilities to discern the outlines of objects, and when our visual acuity is tested, we spend more time examining the edges of objects, their contours and textures, than we do looking at the mass of the objects themselves. This trait probably helped assure survival

millions of years ago when it was convenient to see the fangs of a sabre-tooth tiger protruding over the lip of a cliff, or to perceive the outline of a fish swimming in a brook (see Mills, 1981 and 1982, for a useful summary of the research on these points).

Graphics, whatever the origins of our preference for them, do contribute importantly to our interest in viewing and using videotex screens: surveys of user satisfaction consistently show that people like graphics (Carey & Siegeltuch, 1982; Elton, Irving, & Siegeltuch, 1982), that they would like to see more of them (Teletext, 1982), and that they would be less likely to subscribe to a pay service that did not include graphics (Irving, Elton, & Siegeltuch, 1982).

If graphics are entertaining on first viewing, they apparently do not retain that impact over the long run. For example, Tullis (1981) found that trainees using video displays to learn how to test telephone lines took significantly less time to reach a criterion level when they used a database containing graphics than when they only had access to screens displaying narrative text. With practice, however, they could learn to use the straight-text presentation to achieve equally quick results (accuracy in carrying out the task was not affected by presence or absence of graphics). Other studies on videotex per se also suggest that viewers who are familiar with a particular database may find the time delay necessary to construct a graphic on the screen to be an irritant (Nisenholtz, 1981).

We may eventually see systems develop in which users can specify the degree of graphic enhancement they want--novices to a particular subject might choose to view a considerable proportion of the

information they request in graphic form, while experienced users could request fewer illustrations with their text. And, for everyday use, it seems certain that videotex will continue to put heavy emphasis on graphics for showing such mundane information as weather, economic news, and so on.

One powerful stimulant to further development of graphics-based systems is the high level of popular interest that has greeted microcomputer programs and hardware that incorporate extensive graphics. The Star microcomputer recently introduced by Xerox did not achieve great success, but its innovative use of graphics (including the use of "icons"--images of familiar office objects such as files and waste baskets) was widely acclaimed (Canfield-Smith et al., 1982). And critics have been impressed with the even more extensive use of icons and graphics in Apple's Lisa system (Stewart, 1983; Williams, 1983).

Human factors. There are a number of other variables that may affect how people react to videotex systems. Some of these are very basic: parts of the population, for example, are color-blind (5%) or functionally illiterate (10-15%); many have not kept their eyeglass prescriptions up to date, or have other problems that prohibit them from seeing as well as they should (perhaps as much as 33%). All these are conditions that would make it difficult to use parts of a videotex system (Carey & Siegeltuch, 1982). Other problems include basic mechanical ineptness (empirically shown to be more common among older people and less common among teenagers)--a survey of TV repairers, for example, showed that 15% of service calls revealed sets that were not plugged in (Carey, 1981a).

Another potential problem is that some--perhaps most--of the graphic and design conventions used in videotex systems will be novel. There is no commonly agreed-upon "grammar" of graphic elements at present (Nisenholtz, 1981; Warfield, 1979), and although users may figure out the specifics of a particular system and even develop their own ways of adding graphic patterns to their "electronic mail" (Carey, 1980), it will doubtless take some time for users to become familiar with a new range of symbols and conventions that will develop around videotex.

The tendency of videotex users to scan, rather than read, screens poses a further problem. Among other things, reading is a habit, and people have become used to the way that printed pages look. Readers thus have patterns built up that allow them to peruse a page of printed material in ways that are familiar and comfortable. While some of these ways of dealing with printed matter have to do with the psychological manner in which the material is processed, other aspects of reading habits include the physical setting for reading and the time of day during which one reads, and the amount read at any given sitting (see, e.g., Carey, 1981b, 1982). While some of these habits may continue unchanged when one switches to reading videotex materials, other habits will need to change, and this may create problems for some readers.

Overall screen design. The above discussion should make it very plain that there is at present no agreement on a single aesthetic for the design and presentation of screen information. One interesting study attempted to separate out the factors that contribute to users' preferences for particular screens over others. Three factors were

identified: attractiveness, which includes the separate elements of color and graphics; clarity, which has to do with the arrangement of material on the screen, the legibility and size of individual "chunks" of information; and usefulness, which relates specifically to the perceived value of the content (Champness & DiAlberdi, 1981).

What seems to be developing is a set of standards that are somewhat different from the existing canons of print materials design. These standards take into account users' tendencies to scan (rather than read carefully) videotex screens; to see color as important to meaning, and to perceive certain colors more readily than others; and to find graphics convivial tools for learning, especially when new material or new concepts are involved. Should videotex or its offspring achieve a significant role in providing information to the populace at large, these standards may eventually come to be as formative an influence on our thinking as have standards for the design of printed materials.

Finding One's Way: Of Indexes, Menus, Keywords and Audit Trails

Videotex is based on a novel premise--that members of the general populace need the kinds of information that can readily be converted to electronic form and made available through such systems, that they are willing to take the time and spend the energy to look for that information, and (most importantly) that they have the requisite skills in information science to search effectively. As we shall see in this section, those are large assumptions; the extent to which designers are warranted in making them may determine the future of electronic information systems in general and of videotex in particular.

On using a videotex system, the novice soon comes to feel that only a small fraction of the total time spent is devoted to scanning information on the screen. A large, and sometimes frustrating, amount of time is spent finding out where one is, where one wants to go, why one didn't get where one thought one was going, and how one can retrace one's steps through an often-confusing electronic landscape. If that landscape is well marked with directional signs to answer those questions that arise, then the search for information can be less exasperating. But when there are few clues to guide the seeker's way, the task may become so difficult that the user simply gives up. In this section, we shall consider two central aspects of this question of "way-finding" in videotex: the design and use of indexes, and the user's sense of location within the database at any given moment, or what some have called "interpanel navigation."

Menu-based indexes. As videotex began to develop in the 1970s, it quickly became clear to system designers that indexing would be a major problem. Large databases with access provided by computers had existed before, of course, but they had been used only by small groups of specialists--data processing professionals, on-line search librarians in large research libraries, and so on. Access to the materials in such databases (of which the numerous bibliographic systems in the sciences, medicine, and law are excellent examples) was to be provided through keywords--terms that would be selected in advance, defined to have particular meanings, and used to enter and extract material from the computerized "master file." Although amateur searchers could use without undue hardship the printed indexes that usually accompanied

these databases, the real potential of on-line bibliographic searching could only be realized by someone who not only had a terminal connected to the system, but who also knew something about Boolean operators and how to tie keywords together to create an efficient search strategy.

How then to get around the seemingly large obstacle of a public untrained in on-line searching who now nonetheless were to be expected to operate a sophisticated computerized information system? Designers of early videotex databases turned to the use of "menus" (also sometimes called "index trees") as the least problematic solution. The menu--a list of choices presented to the user on the screen--would compensate for lack of computer expertise by forcing all decisions into simple "yes-no" or "which-of-the-following-do-you-want" formats. The menu could also limit the amount of information that the user would have to deal with at any given time by presenting even the most complicated searches as a series of relatively simple choices from a succession of menus (or "roots" to the tree). While this approach might be slow, it was argued, users would benefit over the long run by having an "idiot-proof" system.

The user would not even need to learn how to type; all menu options would be numbered, so that everything could be done using a keypad similar to a telephone touch pad. Virtually all of the videotex systems in operation today--Prestel, Ceefax, Oracle, and many of those undergoing field trials in the US--employ some version of a menu indexing system.

Menus are in fact relatively efficient in some ways. In a survey of British teletext users, 76% said that information was "easy to find"

(Teletext, 1982). But that perception is not supported by the bulk of the evidence: one study found that, in working through the 6 to 14 steps required in the average information search, 50% of users had to backtrack at least once, and 20% never reached their target at all (Carey, 1981a). Another study found that 28% of users terminated their searches before finding the data that they needed, even when they knew that the information was in the database (Latremouille et al., 1981). In an environment of technically sophisticated users, menu searches of an electronic library catalog were much less popular (21% of all searches) than were keyword searches (79% of searches; Geller & Lesk, 1982).

The problem with menu-based indexes seems to be in the assumptions that underlie them. To avoid confusing naive users with complicated structures of keywords and unfamiliar search strategies, system designers succeeded in setting up new opportunities for confusion in the structure of the menu itself. The reason for this is that users have difficulty figuring out what specific types of information are subsumed under the rather general headings that must be used in the "first root" of the index tree. If one wants to reserve a hotel room, for example, should one select the branch of the tree headed "leisure" or that headed "travel"? One study found that 79% of mistakes occur either on the first root or on the one immediately following it (Latremouille et al., 1981). In a field trial, users spent 18% of <u>all time</u> on the system with the main index, and 23% on sub-indexes; only 59% of time was spent on content frames themselves (Irving, Elton, & Siegeltuch, 1982).

A number of procedures have been developed to cope with some of the

most severe problems created by menu-based indexes. For example, the number of sub-indexes that one must pass through in order to reach a particular content frame can be reduced by increasing the number of options presented on the first index (McFarland, 1982), a procedure that users seem to like (Latremouille et al., 1981). Users can be involved in the process of determining what categories are going to be used at the base levels of the index. And the system itself can be designed to present the user with a "paradigm," a diagrammatic or other representation of how a particular search might best be structured (Lochovsky & Tsichritzis, 1981).

When pressed, however, most videotex system designers would probably admit that menu-based indexing is a problem that they would rather be rid of. Searches based on keywords are faster, less frustrating, and more likely to lead the user to desired information. But the specifics of a keyword-based index for mass use are still unclear, and the assumption that people could learn how to use such a system is still largely untested.

<u>Keyword-based indexes</u>. It is clear that, when presented with the option of using either a menu-based or a keyword-based index, users will choose the keyword index as being easier and more rewarding. In the Geller and Lesk study (1982), noted above, use of the keyword index grew over time, and for good reason: 69% of keyword users found relevant materials, in comparison with only 36% of menu users, and what they found was more valuable. Experiments in progress in Denmark have also shown that the public can learn to search effectively with keywords (Orsnaes, 1982). In no case, however, has a videotex system been

proposed in which all access would be by way of keywords.

The reasons for this are subtle but important. First, naive users seem to have a great deal of difficulty in making fine distinctions among related terms. Weyer (1982), in an interesting study done at Xerox's Palo Alto Research Center, examined students trying to use keywords to search through a "dynamic" electronic history textbook. Most problems arose either from a too-restricted use of terms (e.g., insistence on using the adjective, "French," to find a list of French kings, rather than switching to the more general term, "France"), or from ignorance over which terms were significant (e.g., neglecting to use the adjective, "Holy," in a search for information about the Holy Roman Empire, and thereby winding up in a section on the Roman Empire).

Lack of familiarity with the system is a second problem that designers have encountered in trying to develop keyword indexes for general use. Users new to a particular system may not have a very clear idea of what is in the database, and therefore may not even know what keywords might work (see, e.g., Shneiderman, 1978, 1980).

All of the studies reported here limited themselves to asking whether users could learn to handle searching with single keywords. None even ventured to ask if naive users could cope with Boolean operators. And yet, some more complex search strategy would seem to be inevitable if videotex is really to fulfill its potential as a mass medium of information. Clearly more work will need to be done on both systems development and user orientation.

Interpanel navigation: A sense of where you are. Using the index is only part of the battle. One also needs to have a sense of where one

is in the database--an image, either actually before one or in mind, of where one has come from, where one is going, and what alternate paths one might have taken at earlier points in the search. For example, if one were looking for information on current events in Poland, and got sidetracked into a section of the database dealing only with Polish economic statistics from the nineteenth century, it would help to be able to see a list of the index screens or keywords one had used in getting into that unwanted data in the first place. Without this information, the user could very quickly feel "marooned in electronic space."

Designers seem united in their determination to try to help the user in this regard. Demands abound in the literature for "user-friendly" maps of electronic data (e.g.: Marcus, 1982; Baber, 1982), but relatively few specific examples have appeared. Suggestions that have been advanced include: retaining a "route map" or "audit trail" of previous steps on the screen so that the user can always backtrack easily (Engel & Granda, 1975; Lochovsky & Tsichritzis, 1981); using isotype graphics, color, or other coding schemes to cue the searcher to the present location in the database (Mills, 1981); and breaking long videotex screen numbers into three- or four-digit groups for easier recall and reference (Hearty et al., 1982). This is still an area of evolving practice, however, and much new work will need to be done before standards begin to emerge.

Controlling Access to Videotex Resources: Three Issues

To this point, I have discussed variables in the design of screens

and in the preparation of indexes--features that might make it more or less easy for one to use a videotex system. There remain, however, some very serious policy questions that videotex raises in a unique way about just who will be able to use such systems in the first place, and about how the content of videotex databases will be determined and controlled. As we consider the potential for using videotex-like data bases in instructional settings, we must see such questions as central. These issues, taken together, fall under the general rubric of access control.

Three problems in particular warrant our attention: (1) What controls will system operators place on information so as to allow entry to databases for some users while excluding others? (2) What sorts of market forces will operate to raise or lower the cost of videotex services? (3) And what steps must be taken to assure that data collected about individual users' searches for information on one topic or another will not be used to violate their individual privacy? These questions are large and complex, and we can only survey them briefly here. Nonetheless, I feel that it is important that we begin to grapple with the underlying questions involved.

Data secrecy and data access. It is fine to talk of the revolution in communication that will come about when everyone is able to gain access to unlimited information from a home terminal. But let us consider a somewhat different scenario. Suppose that I am sick and want to get some information about a drug that my physician has prescribed for me. I have a videotex terminal at home, and since I know that the systems to which I subscribe supposedly contain medical

information, I make my electronic way to the appropriate database. As I try to call up the section on drugs, the screen flashes--not with the information I want, but with a message: "CLOSED USER GROUP--SPECIAL PHYSICIAN ACCESS CODE REQUIRED."

The scenario is not far-fetched. The development and marketing of "closed" videotex systems--even when part of larger, open systems--seems to be one of the growth industries of the decade. Medicine, law, and some technical specialty areas have been especially active in setting up such systems (see, e.g., Aldrich, 1982; GTE, 1981). Of course, there may be good reasons for wanting to restrict access to certain kinds of information; but we must be very careful to distinguish legitimate controls and those that are intended merely to reinforce the monopoly of a particular group or profession on certain types of knowledge.

How to be sure that information sources are not closed, and that there is wide access to data? John Wicklein (1980, 1981) argues persuasively for openness and diversity in the provision of videotex services, maintaining that the best way to assure such variety is to adopt a "common carrier" policy (much as British Telecom did with Prestel, putting on the system information for anyone who had the money to put it there).

Given present-day patterns of development in the United States, however, it seems unlikely that a common carrier policy will emerge here (see, for example, Civiletti, 1982). Rather, we will probably see a welter of small videotex systems, some closed and some more open, some providing a wide variety of information and others very specialized. In many ways, this plethora of databases will make it easier to get access

to a wide variety of information. But we must be alert to the possibility that chaotic conditions in the vieotex market may also make it more difficult to find particular types of material.

Certain kinds of information may soon be made available only in electronic form. This is an increasing likelihood as costs of printing and distribution rise. And it may become a serious matter if professional groups see videotex as offering a way to enhance their positions through restricting access to information on which the profession rests. To return to the example used earlier, if I were truly interested in getting the information on that drug, I could probably today find it in print in a large medical library (assuming that I had access to such a library, knew how to use it, and so on)--in other words, it would "be there," somewhere, if I were sufficiently motivated to locate it. But what if that information is available only electronically, to one who is equipped with the proper access codes? This question will require careful thought and much more public debate than has been the case up to this point.

The cost of access. Perhaps it goes without saying that we should be concerned with how much videotex services will cost, and how those pricing decisions will be made. If we are concerned about the use of videotex toward educational ends, we must face the fact that equity in access to databases (as with any other sort of equity) is not likely to arise from a laissez faire policy. Are we to provide "information stamps" tomorrow in the same way that we provide food stamps today?

Cost is important to consider for a more mundane reason as well. If people do not understand how a service is priced, they will probably

use it less frequently. Executives of the Prestel system discovered this when potential customers could not figure out the (admittedly Byzantine) procedures British Telecom had developed for pricing services (Kerr, in press; Thompson, 1982). At present in the United States, the cost for access to videotex-like databases varies rather dramatically, from less than $5.00 per hour for slow (300-baud) service on hobbyist systems during after-midnight hours, to more than $100 per hour for fast access to specialized databases during prime time. What is a fair rate for videotex services used for instructional ends, what are the separate componenets of that rate, and who, ultimately, should pay--individual students, schools, governmental agencies?

"Now about this list of data you accessed...." Privacy in the use of videotex services is another question of access, though in this case we are concerned about access by outside parties to what other individuals have sought information about. The issue is not a new one--the confidentiality of personal and public records has long been a subject of interest for philosophers and lawyers. If I have reason to suspect that someone is planning a terrorist attack, for example, would I be warranted in demanding to see library records to discover whether that person had checked out books dealing with explosives? The importance of the question for videotex, however, stems from the ease with which records about individuals' behavior can be generated.

Perhaps educators should have special concerns in this area. Freedom of inquiry without fear of someone else's discovering what one has been reading or thinking (various library censorship cases and book burnings notwithstanding) has had a long and still usually honored

place among the ideals of education in the United States. Would these traditions stand up, however, in the face of systems that might, for example, give young people easy access to materials on (for example, given current controversies) birth control?

Interestingly, those who operate interactive systems seem equally worried about this question, perhaps because they sense that there is deep public concern about it. The Warner-Amex QUBE system in Columbus, Ohio, for example, has been in operation for five years. And although there have been attempts by outsiders to acquire information about who has seen/requested/accessed what, the company has steadfastly resisted all such efforts (Plesser, 1982). To assure rational policy formation, we may need to monitor developments in this area carefully in the future.

Conclusions: The Implications of Videotex for Education and Instruction

What are the conclusions that we can sensibly draw from this review? Does videotex in fact have a future in education, or is it merely another "flash in the pan," another foot soldier in that vast army of instructional innovations that have made their way over the educational landscape during the past three decades, leaving little evidence of their passage except for locked closets full of dusty equipment? I maintain that videotex *is* likely to have a strong effect on education, but probaly not in the ways we might first think.

Our usual tendency is to think of educational innovation as affecting classroom practice. Videotex may in fact find a limited role there, but at the present time, it will probably not have a significant

impact. The reasons for this are several--the systems are just developing; they are likely to be first directed toward the business market, then toward home and entertainment use, and only toward education as an afterthought; and costs are likely to be such that it would be difficult for any school to make videotex a significant avenue for instruction.

Where videotex is likely to have an impact is in the area of design and presentation of printed and graphic materials. That, after all, is the forte of the systems we have examined here. And the ways in which videotex materials must be structured are not unique to any particular system, but are rather generic to any system that proposes to distribute textual and graphic information electronically.

I submit that we are likely to see interesting developments during the coming decade in such areas as the design of interactive texts, the construction of electronic systems that will allow users to easily find their ways through very complex information structures, and the enhancement of all sorts of instructional materials via novel graphic procedures made possible by current computer technology. What is truly exciting is not merely the probability that these things will come to pass, but that they will encourage us to take a fresh look at how learners work with instructional materials, how they "learn how to learn" from a variety of formats. Most importantly, videotex may push us into new realizations about the interconnections among existing print technologies and the emerging electronic technologies of the coming age.

References

Aldrich, M. World review of private videotex. In Videotex--Key to the information revolution. Proceedings of Videotex '82, New York, N.Y., June, 1982. Northwood Hills, U.K.: Online Conferences, Ltd., 1982.

Baber, R. Software reflected: The socially responsible programming of our computers. Amsterdam/New York: North Holland/Elsevier, 1982.

Canfield-Smith, D., Irby, C., Kimball, R., Verplank, B., & Harslem, E. Designing the Star user interface. Byte, 1982, 7(4), 242-282.

Carey, J. Paralanguage in computer-mediated communication. Proceedings: Association for Computational Linguistics. Philadelphia, Pa.: University of Pennsylvania, 1980.

Carey, J. Human factors in videotex. Bronx, N.Y.: Greystone Communications, 1981. (a)

Carey, J. Consumer information habits. Bronx, N.Y.: Greystone Communications, 1981. (b)

Carey, J. Videotex: The past as prologue. Journal of Communication, 1982, 32(2), 80-87.

Carey, J., & Siegeltuch, M. Teletext usage in public places. Research on broadcast teletext: Working paper No. 8. New York: New York University, Alternate Media Center, 1982.

Champness, B., & DiAlberdi, M. Measuring subjective reactions to teletext page design. New York: New York University, Alternate Media Center, 1981.

Civiletti, B. Videotex: Content control and the first amendment. In Videotex--Key to the information revolution. Proceedings of Videotex '82, New York, N.Y., June, 1982. Northwood Hills, U.K.: Online Conferences, Ltd., 1982.

Elton, M., Irving, R., & Siegeltuch, M. The first six months of a pilot teletext service: Interim results on utilization and attitudes. Research on broadcast teletext: Working paper No. 6. New York: New York University, Alternate Media Center, 1982.

Engel, F. Information selection from visual display units. In E. Grandjean & E. Vigliani (eds.), Ergonomic aspects of visual display terminals. London: Taylor & Francis, Ltd., 1980.

Engel, S., & Granda, R. Guidelines for man/display interfaces. Technical report 00.2720. Poughkeepsie, N.Y.: IBM Poughkeepsie Laboratory, 1975.

Fedida, S., & Malik, R. The viewdata revolution. London: Associated Business Press, 1979.

Foster, J., & Champness, B. Attractiveness and readability of text and tables. In Videotex--Key to the information revolution. Proceedings of Videotex '82, New York, N.Y., June, 1982. Northwood Hills, U.K.: Online Conferences, Ltd., 1982.

Friedman, M. Super screens. Amtrak Express, March, 1983, 3(3), 30-42.

Geller, V., & Lesk, M. How users search: A comparison of menu and attribute retrieval systems on a library catalog. Paper presented at the annual meeting of the ASIS, Columbus, Ohio, October, 1982.

Godfrey, D., & Chang, E. The Telidon book. Toronto: Press Porcepic, 1981.

GTE plans new videotex databases. ASIS Bulletin, 1981, 8(1), 9.

Hamlyn, M. Fireside access to sum of human knowledge. London Times, February 24, 1981, 15.

Hartley, J. Designing instructional text. New York: Nichols, 1978.

Hearty, P., Lee, E., & Phillips, D. Data entry in videotex: Keypad design and page number format. Telidon behavioural research No. 4. Ottawa: Department of Communications, 1982.

Irving, R., Elton, M., & Siegeltuch, M. The last five months of a pilot teletext service: Interim results on utilization and attitudes. Research on broadcast teletext: Working paper No. 7. New York: New York University, Alternate Media Center, 1982.

Kerr, S. Videotex at street level: Public awareness of viewdata services in Great Britain. Videodisc/Videotex, in press.

Kiester, E., Jr. Information, plus. TV Guide, January 15, 1983.

Kolers, P., Duchnicky, R., & Ferguson, D. Eye movement measurement of readability of CRT displays. Human Factors, 1981, 23(5), 517-527.

Latremouille, S., Lee, E., Mason, C., McEwen, S., Phillips, D., & Whalen, T. The design of videotex tree indexes. Telidon behavioural research No. 2. Ottawa: Department of Communications, 1981.

Lochovsky, F., & Tsichritzis, D. Interactive query languages for external databases. Telidon behavioural research No. 5. Ottawa: Department of Communications, 1981.

MacDonald-Ross, M. Language in texts. In L. Shulman (ed.), Review of research in education. No. 6. Itasca, Ill.: Peacock, 1978.

Marcus, A. Designing the face of an interface. IEEE Transactions on Professional Communication, 1982, 3, 122-126.

McFarland, P. New skills for old: The key to creative videotex production. In Videotex--Key to the information revolution. Proceedings of Videotex '82, New York, N.Y., June, 1982. Northwood Hills, U.K.: Online Conferences, Ltd., 1982.

Mills, M. A study of the human response to pictorial representations on Telidon. Telidon behavioural research No. 3. Ottawa: Department of Communications, 1981.

Mills, M. Evaluating the impact of videotex images. In Videotex--Key to the information revolution. Proceedings of Videotex '82, New York, N.Y., June, 1982. Northwood Hills, U.K.: Online Conferences, Ltd., 1982.

Nisenholtz, M. Early use of graphics in the field trial in Washington, D.C. Research in broadcast teletext: Working paper No. 3. New York: New York University, Alternate Media Center, 1981.

Oranaes, J. User reactions to keyword-access videotex. In Videotex--Key to the information revolution. Proceedings of Videotex '82, New York, N.Y., June, 1982. Northwood Hills, U.K.: Online Conferences, Ltd., 1982.

Plesser, R. What's being done about privacy? In Videotex--Key to the information revolution. Proceedings of Videotex '82, New York, N.Y., June, 1982. Northwood Hills, U.K.: Online Conferences, Ltd., 1982.

Reynolds, L. Teletext and viewdata--A new challenge for the designer. Information Design Journal, 1979, 1(1), 2-14.

Rice, S. Book design: Systematic aspects. New York: Bowker, 1978.

Shneiderman, B. Improving the human factors aspect of database interactions. ACM Transactions on Database Systems, 1978, 3(4), 417-439.

Shneiderman, B. Software psychology. Cambridge, Mass.: Winthrop, 1980.

Sigel, E. (ed.) Videotex. New York: Harmony Books, 1980.

Siegeltuch, M. Text on screen and print: A comparison of forms. New York: New York University, Alternate Media Center, 1982.

Status of the videotex industry. Videoprint, January 10, 1983, 4(1), 1-5.

Stewart, G. A first look at Lisa. Popular Computing, March, 1983, 2(5), 84-92, 174-184.

Sutherland, S. Prestel and the user. Brighton, U.K.: University of Sussex, 1980.

Teletext in the UK: A market research study. New York: CSP International, 1982.

Thompson, V. Using Prestel in educational applications. In Videotex--Key to the information revolution. Proceedings of Videotex '82, New York, N.Y., June, 1982. Northwood Hills, U.K.: Online Conferences, Ltd., 1982.

Tullis, T. An evaluation of alphanumeric, graphic, and color information displays. Human Factors, 1981, 23(5), 541-550.

Tydeman, J., Lipinski, H., Adler, R., Nyhan, M., & Zwimpfer, L. Teletext and videotex in the United States. New York: McGraw-Hill, 1982.

Waller, R., Lefrere, P., & MacDonald-Ross, M. Do you need that second color? IEEE Transactions on Professional Communication, 1982, 25(2), 80-85.

Warfield, J. Some principles of knowledge organization. IEEE Transactions on Systems, Man, and Cybernetics, 1979, 9(6), 317-325.

Weyer, S. The design of a dynamic book for information search. International Journal of Man-Machine Studies, 1982, 17, 87-107.

Wicklein, J. The electronic nightmare. Boston: Beacon, 1981.

Wicklein, J. Guaranteeing diversity in the new communications. In Videotex--Key to the information revolution. Proceedings of Videotex '82, New York, N.Y., June, 1982. Northwood Hills, U.K.: Online Conferences, Ltd., 1982.

Williams, G. The Lisa computer system. Byte, February, 1983, 8(2), 33-50.

Woolfe, R. Videotex. London: Heyden, 1980.